ENTRANCE EXAMINATIONS – 2022

Ph.D. Biochemistry

B-7

Hall Ticket No.	

Time : 2 hours Max. Marks : 70

Instructions

Please read the following instructions carefully before answering:

1. Enter Hall Ticket number in the space provided above and also on OMR sheet.
2. Paper contains two sections: Part A and Part B together with 60 questions for 70 marks. **Part A contains 25 questions. Questions 1 to 15 carry one mark each. Questions 16 to 25 carry 2 marks each. Part B contains 35 questions; each question carries one mark.** There is no negative marking in any section.
3. Answers have to be marked on the OMR sheet as per the instructions provided.
4. **Please return the OMR answer sheet at the end of examination.**
5. Apart from OMR sheet, the question paper contains 11 (eleven) pages including the instructions.
6. No additional sheet will be provided. Rough work can be carried out in the question paper itself in the space provided at the end of the booklet.
7. Non programmable calculators are allowed.

Part A

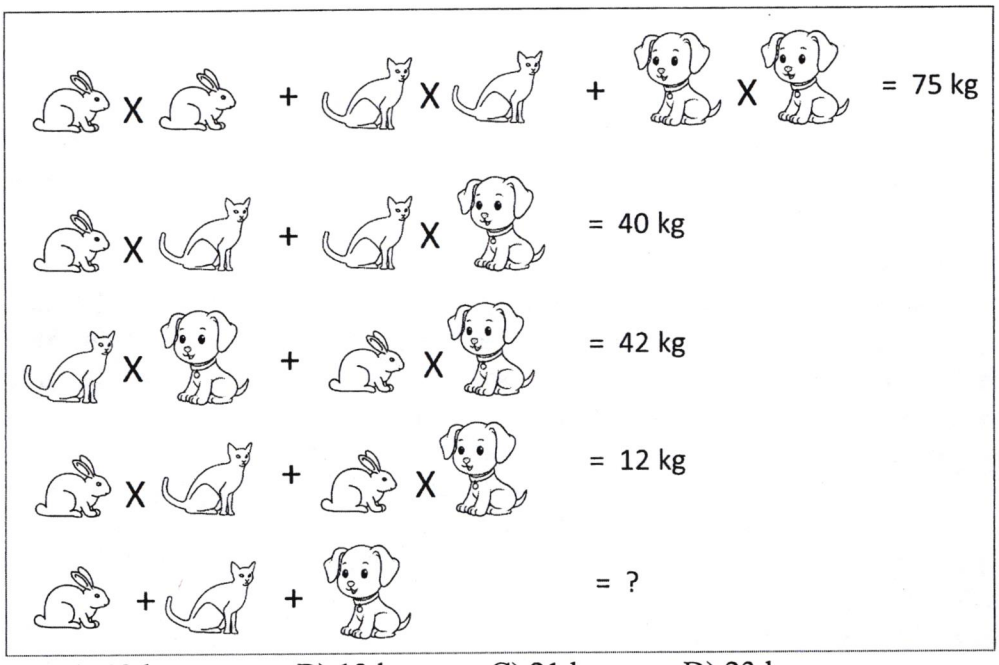
1) You have isolated DNA polymerases from 25 different organisms, and you want to identify the top three fastest polymerases among them. You have set up an assay that would compare the relative rates of the enzymes, but won't determine the absolute rate of any enzyme. In your experimental system, you can run up to five reactions at a time and thus can investigate a maximum of five enzymes per experiment. In order to rank the top three fastest enzymes what would be the minimum number of experiments you need to set up?

A) 6 B) 7 C) 8 D) 10

2) Dr. Pradhan started walking 100 m to the south of his office. He then turned left and continued for 50 m. Then he turned north and walked for 40 m. He then got an urgent call so changed his direction to walk towards his office. In which direction is he walking now?

A) West B) South-West C) North-West D) South-East

3) From the following figure, find out the missing value:



A) 12 kg B) 13 kg C) 21 kg D) 23 kg

4) An aspartate ammonia lyase would catalyze which one of the following reactions?

A) Transamination
B) Deamination
C) Transimination
D) Decarboxylation

5) From the Lineweaver-Burk plot of inhibition studies of an enzyme it was concluded that it is an uncompetitive inhibition. Which one of the following observations would have directed to the conclusion?

A) The V_{max} decreases, K_M decreases, the inhibitor binds to the ES complex
B) The V_{max} decreases, K_M decreases, the inhibitor binds to the substrate site
C) The V_{max} decreases, K_M remains same, the inhibitor binds to the ES complex
D) The V_{max} remains same, K_M increases, the inhibitor binds to the substrate site

6) The following statements are related to the lysosomes.

I) The lysosomal lumen pH is ~4.5 to 5.0.
II) Centrifugation at 1,00,000 x g can be used to isolate a lysosomal fraction from the liver cell extracts
III) Phosphate esters, nucleases, sulphatases, phosphatases, lipases, and glycosidases are the components of lysosomes
IV) Lysosomes are involved in autophagy

Choose the combination that has all the correct answers.

A) I, II and III only
B) I &II only
C) I, II and IV only
D) I, III and IV only

7) You would like to determine the contamination of bacterial or mitochondrial ribosomes in the cell-free translational systems you prepared from an eukaryote source. To achieve this, the best way would be to determine protein synthesis in this system in the presence of

A) rifampicin B) cycloheximide C) streptomycin D) chloramphenicol

8) Which one of the following organelles is enclosed by a single membrane?
A) Nucleus B) Mitochondria C) Chloroplast D) Endoplasmic reticulum

9) What is a peptide anticodon in protein synthesis?
A) A peptide anticodon is a sequence of nucleotides present in the tRNA that recognize the codons in mRNA
B) A peptide anticodon is part of elongation factor 2 that recognizes a specific amino acid sequence in the elongation step in protein synthesis
C) A peptide anticodon is sequence of specific amino acids present in release factor1 involved in the termination of protein synthesis
D) A peptide anticodon is a sequence of specific amino acids present in the ribosome recycling factor (RRF) in prokaryotes

10) Which one of these proteins serves as a guanine nucleotide exchange factor?
A) Bacterial Initiation factor 2 (IF2)
B) Bacterial Elongation factor, EF.Tu
C) Bacterial Elongation factor, EF.Ts
D) Bacterial Elongation Factor, EF.G

11) A globular protein in a certain experimental condition aggregates to form either a tetrahedral tetramer or a linear tetramer. If the mixture is chromatographed on size-exclusion chromatography, which will elute first?
A) Tetrahedral form will elute first
B) Linear will elute first
C) Both forms will elute together
D) None will elute

12) When X-rays of wavelength 1.5 Å are scattered by a protein crystal, which one of the following conditions is required to observe a peak of diffraction intensity?
A) The angle of incidence is half of the angle of scattering.
B) The path length difference between two scattered lights is equal to 1.5 Å
C) If the scattering angle is double to incidence angle
D) If diffracting planes are parallel to the incident light

13) The applied centrifugal field at a point 5 cm in a cell from the center of rotation of centrifuge whose angular velocity of 4000 rad s^{-1} is
A) 2×10^3 rad^2 cm s^{-1}
B) 8×10^4 rad^2 cm s^{-1}
C) 8×10^7 rad^2 cm s^{-1}
D) 2×10^7 rad^2 cm s^{-1}

14) Peptide bonds geometry can be estimated by
A) Circular dichroism B) Raman spectroscopy
C) XRD D) ESR

15) MicroRNAs are important gene regulators, but the miRNAs are also regulated in turn by other RNAs. Which of the following classes of RNA are known to regulate miRNAs?

A) Ribosomal RNA B) Long non-coding RNA
C) Transfer RNA D) Messenger RNA

16) What is the pH of a 1L solution prepared in water by adding 0.2 mol of acetic acid and 0.02 mol of NaOH? p*Ka* of acetic acid is 4.75.

A) 3.75 B) 4.38 C) 5.75 D) 4.75

17) Identify the correct statements about the fate of carbon skeletons of amino acids.

i. Glucogenic amino acids can give rise to glucose.
ii. Ketogenic amino acids can give rise to acetyl-CoA.
iii. Ketogenic amino acids can be converted to mevalonate.
iv. Some amino acids are both glucogenic and ketogenic.

A) i & ii B) i & iii C) iii & iv D) i, ii, & iv

18) Using hepatocyte as a model system, Sutherland examined the effect of epinephrine on glycogen breakdown and measured various biochemical activities of the liver extracts (a-d).

a. Glucose synthesis
b. cAMP production
c. Protein phosphorylation
d. adenylate cyclase activation

The correct order of sequence of events representing epinephrine-mediated glycogen breakdown in liver cells is:

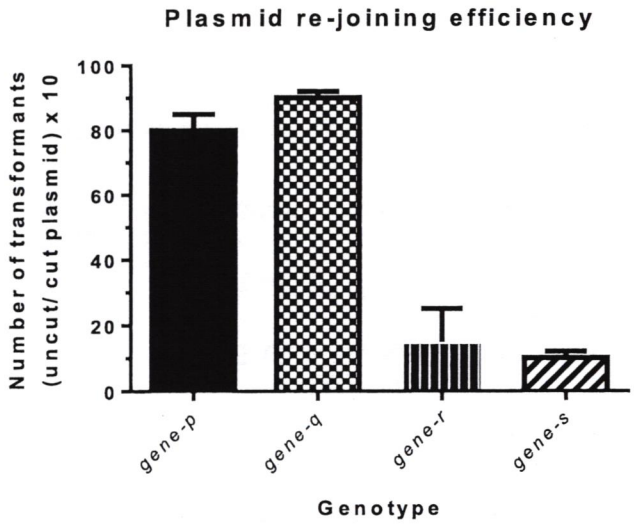
A) a-d-c-b B) d-c-b-a C) d-b-c-a D) d-b-a-c

19) Match the following mammalian histone variants with their predominant roles:

Histone Variants	**Associated Function**
1. H2A.Z	(a) X-chromosome inactivation
2. CENP H3	(b) DNA damage signaling
3. Macro H2A	(c) Male gametogenesis
4. H2A.X	(d) Active transcription promoters
5. H3.3	(e) Centromeric Histones

A) 1-d; 2-e; 3-a; 4-b; 5-c
B) 1-a; 2-e; 3-d; 4-b; 5-c
C) 1-a; 2-e; 3-c; 4-d; 5-b
D) 1-b; 2-e; 3-c; 4-d; 5-a

20) In order to determine the genes involved in NHEJ mediated DNA double-strand break repair, you performed the plasmid-re-joining assay, where you transform each mutant cell either with a cut-plasmid or an uncut circular plasmid, and then score for the efficiency of end-joining in that particular mutant background. This assay works on the principle that once the cut plasmid is re-joined within the cell to produce circular plasmid, then only a transformant is obtained. From the accompanying graph, infer the genes that are likely to be involved in NHEJ. Mutant genotype is written as *gene-p* and wild-type genotype is written as *GENE-P* etc.



A) Only *GENE-P*
B) *GENE-P* and *GENE-Q*
C) Only *GENE-R*
D) *GENE-R* and *GENE-S*

21) Following are the phenotypes of two temperature sensitive (ts) mutants of two essential genes *ess2* and *ess5*. + indicates ability to grow at that temperature.

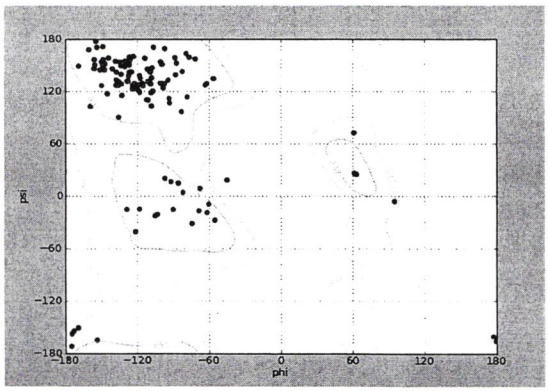
	32°C	37°C	42°C
ess2 (ts)	+	-	-
ess5 (ts)	-	-	+

What would be the phenotype of an *ess2 (ts) ess5 (ts)* double mutant?

A) The double mutant will grow at 37°C
B) The double mutant will grow at 32°C
C) The double mutant will grow at both 32°C and 42°C
D) The double mutant will be inviable at all the three temperatures

22) In bacterial cells, catabolite repression allows the cells to save energy by
A) Inactivating catabolic enzymes
B) Inhibiting synthesis of total RNA
C) Regulating the expression of genes required for utilization of less-efficient metabolites
D) Inhibiting translation of mRNAs encoding catabolic enzymes

23) The following Ramachandran plot most corresponds to:



A) Alpha-helical protein
B) β-barrel protein
C) Collagen protein
D) Glycine-rich protein

24) Many biochemical reactions are thermodynamically unfavorable. However they occur in cells, through coupling with other reaction(s) especially the reaction: ATP → ADP + Pi. Based on this information, which of the following can be true:

A) Delta $G^{0'}$ for ATP hydrolysis = 0
B) **Delta $G^{0'}$ for ATP hydrolysis is NEGATIVE**
C) Delta $G^{0'}$ for ATP hydrolysis is POSITIVE
D) ATP is the most abundant metabolite

25) The table below has columns indicating the immune mediators and types of hypersensitivity.

Column 1: Immune mediators	Column 2 Type of Hypersensitivity
a. IgG and IgM mediated complement activation and antibody-dependent cell cytotoxicity	(i) Type I
b. IgE induced mast cells and basophils degranulation	(ii) Type II
c. Sensitized T cells	(iii) Type III
d. IgG bound soluble antigens forming immune complexes	(iv) Type IV

Select the option with all correct matches.

A) a-(i); b-(ii); c-(iv); d-(iii)
B) a-(i); b-(iii); c-(iv); d-(ii)
C) a-(ii); b-(i); c-(iv); d-(iii)
D) a-(i); b-(ii); c-(iii); d-(iv)

PART B

26) A physician prescribed statin to his patient suffering from myocardial infarction. Which of the following would be the specific activity of statin?

A) Statins decrease serum LDL levels
B) Statins increase serum HDL levels
C) Statins inhibit conversion of VLDL to LDL
D) Statins inhibit HMG Co-A reductase

27) Identify the correct statement about the reaction catalyzed by ribonucleotide reductase (RNR).

A) RNR converts NMP to dNMP
B) RNR converts NDP to dNDP
C) RNR converts NTP to dNTP
D) RNR can convert NMP, NDP, NTPs to dNMP, dNDP, and dNTP respectively.

28) The micronutrient essential for synthesis of purines is

A) Folic acid B) Riboflavin
C) Niacin D) Thiamine

29) Which one of the following biochemical events ensures the translocation of electrons produced into mitochondrion during glycolysis?

A) Electron Transport Chain B) Cori-cycle
C) Malate-aspartate shuttle D) Hexose monophosphate Shunt

30) Which of the following post-translational modifications of histone proteins are recognized by chromodomain containing proteins?

A) Methylation B) Acetylation C) Glycosylation D) SUMOylation

31) Which of the following event is NOT involved in eukaryotic mRNA splicing?

A) Formation of spliceosome complex
B) Formation of 2'→5' phosphodiester bond
C) Formation of lariat intermediates
D) Coupling of phosphodiester bond formation to ATP hydrolysis

32) Increasing the concentration of which of the following would most effectively antagonize the inhibition of protein synthesis by puromycin?

A) GTP B) ATP C) Peptidyl- tRNA D)Aminoacyl tRNAs

33) Anaphase promoting complex (APC/C) has which one of the following enzymatic activity?

A) Protein kinase B) Phosphatase
C) Ubiquitin ligase D) Deubiqutination

34) The CpG islands, the sites of DNA methylation in mammalian genomes, are:

A) present more often than expected by random chance.
B) present in frequencies as expected by random chance.
C) present less often than expected by random chance.
D) absent from mammalian genomes.

35) Which of the following organelles contain DNA?

A) Nucleus only B) Mitochondria and peroxisomes only
C) Nucleus and mitochondria only D) Nucleus, mitochondria and chloroplast

36) Which one of the following techniques is best suited to estimate the molecular weight of a given protein?

A) SDS-Polyacrylamide gel electrophoresis
B) Isoelectric focusing
C) Electrophoretic mobility Shift Assay (EMSA)
D) Bradford assay

37) Which one of the following mutagens causes frame shift mutations predominantly?
A) Methyl methane sulfonate
B) Acridine orange
C) Bleomycin
D) Ethyl methane sulfonate

38) Noncoding DNA in eukaryotic cells does not include
A) Introns
B) pseudogenes.
C) simple-sequence repeats
D) mobile genetic elements.

39) Arachidonic acid is an
A) Omega-3 Fatty acid
B) Omega-6 Fatty acid
C) Omega-9 Fatty acid
D) Omega-4 Fatty acid

40) Which of the following is a C3 plant?
A) Maize
B) Sugarcane
C) Rice
D) Sorghum

41) Which one of the following is a tandem enzyme?
A) Phosphofructokinase 2
B) Citrate synthase
C) Phosphofructokinase 1
D) Hexokinase

42) Which of the following two enzymes are glyoxylate cycle specific enzymes?
A) Glyoxylic acid synthase and Malate dehydrogenase
B) Isocitrate lyase and Malate synthase
C) Protein kinase and protein phosphatase
D) Aldolase and Pyruvate Kinase

43) The core oligosaccharide added to asparagine residues in N-glycan synthesis contains
A) 2 N-Acetylglucosamine, 8 Mannose and 3 Glucose
B) 1 N-Acetylglucosamine, 9 Mannose and 3 Glucose
C) 2 N-Acetylglucosamine, 9 Mannose and 3 Glucose
D) 2 N-Acetylglucosamine, 7 Mannose and 3 Glucose

44) To produce one urea molecule via Urea cycle,------- is required.
A) 2 ATP
B) 3 ATP
C) 1 ATP
D) No ATP

45) Glutamine synthetase is regulated reversibly by
A) Adenylation and Deadenylation
B) Phosphorylation and Dephosphorylation
C) Allosteric regulation
D) None of the above

46) The gene for eye colour in dogs has two alleles B and b. B is dominant and codes for black eyes. b is recessive and codes for grey eyes. The possible genotype and phenotypes in this population of dogs are

A) BB, Bb, bb and black and grey

B) B; b. and black and grey only
C) Bb and black only
D) BB, bb and black and grey

47) In pea plants round (R) seeds are dominant over wrinkled (r) seeds. If a plant that produces round seeds came from a parent that produced wrinkled seeds, what is the genotype of this plant?

A) RR B) Rr C) rr D) Ro

48) In a family, the mother had a defect in meiosis leading to high levels of non-disjunction. Therefore, the eggs (gametes) either contained both X chromosomes or no X chromosomes. In the surviving children from this mating, the number of barr bodies produced would be

A) none of the offsprings would have barr bodies B) 1 only
C) 2 only D) 0 or 1 or 2

49) Wild type yeast can be stored in water or low solute containing solutions for days without loss of viability. A yeast mutant defective in cell wall biosynthesis was isolated. When this mutant is stored in water, what would you expect?

A) No effect as the plasma membrane is intact
B) Cells will swell and burst
C) The cells will be thinner due to the defective cell wall
D) Cells will lose water and dry up

50) A protein is synthesized on cytosolic ribosomes. In a pulse -chase experiment to trace the trafficking of this protein within the cell, one is likely to find this protein in
A) cis-Golgi B) nucleus C) vesicles D) lysosomes

51) Which one of the following statements about ion-exchange chromatography is NOT true?
A) Binding of protein to column is done in low ionic strength and eluted at higher ionic strength
B) To bind a protein to a cation exchanger, binding is carried out at a pH lower than pI of protein
C) Proteins bind to exchange resins via non-covalent ionic interactions
D) In anion exchange chromatography, the active groups on the column are negatively charged

52) 25 adult diabetics are observed to have an average fasting blood glucose level of 130 mg/dL with an SD of +/- 40 mg/dL, one can say that
A) estimate of the mean has a precision (SE) of 8 mg/dL
B) estimate of the mean has a precision (SE) of 1.6 mg/dL
C) estimate of the mean has a precision (SE) of 5.2 mg/dL
D) estimate of the mean has a precision (SE) of 26 mg/dL

53) . The following equation is used in BLAST scoring statistics:
$S' = \lambda S - \ln K / \ln 2$
This equation denotes:
A) Expect value B) Raw score
C) Bit score D) Alignment

54) Which of the following microscopes can be used for studying the ultrastructure of mitochondrial inner membrane and **resolving** structures that may be just ~10 nm to 50 nm apart.

A) Confocal microscope
B) Transmission electron microscopy
C) Phase contrast microscope
D) light microscope

55) Mixing sodium metal with water is extremely hazardous and flammable. For this reaction, which of the following is true?

A) Delta G = 0; delta H value is -ve
B) Delta G value is -ve; delta H value is +ve
C) Delta G value is -ve; delta H value is -ve
D) Delta G =0; delta H value is +ve

56) The GTP bound form of Rac-1 GTPase promotes actin filament formation. GAPs are proteins that increase GTPase activity of small GTPases. Overexpressing a GAP specific for Rac-1 is likely to:

A) Increase overall actin filament formation
B) Leave Filamentous actin levels unchanged
C) Increase ratio of filamentous actin to monomeric actin
D) Decrease ratio of filamentous actin to monomeric actin

57) Which of the following reagents are a mandatory requirement for you if you are required to measure the quantity of antibodies present in a patient serum against a toxin from a pathogen?

i) Enzyme conjugated antibodies against human IgG
ii) Purified toxin of the pathogen
iii) Polyclonal human IgG against the pathogen toxin

A) i only B) ii and iii only C) i and ii only D) i and iii

58) Under which of the given conditions might an antigen presenting cell (APC) bind an antigen for presentation through MHC class II molecule?

A) When APC is treated with paraformaldehyde about 2hrs post antigen exposure
B) When APC is treated with paraformaldehyde and then incubated with native antigen
C) When APC is treated with paraformaldehyde and then incubated with the antigen partially digested with enzyme
D) Under conditions of both A and C

59) Which of the following statements are false about Gram's staining?
A) Gram-positive bacteria retain the crystal violet stain because they have a thick multilayer sheet of peptidoglycan.
B) Gram-negative bacteria do not retain crystal violet stain because they have a thick layer of teichoic acids
C) The peptidoglycan of Gram-positive bacteria is often decorated with sugars and proteins that help the bacteria attach to surfaces and interact with the environment.
D) The periplasmic space is very thin in Gram-positive bacteria

60) Which of the following viruses carry reverse transcriptase enzyme in their capsid?
A) RNA viruses
B) DNA viruses
C) Single stranded DNA viruses
D) Retroviruses

University of Hyderabad
Ph.D. Entrance Examinations - 2022

School/Department/Centre : Department of Biochemistry, Life Sciences
Course : Ph.D. **Subject : Biochemistry**

Q.No.	Answer	Q.No.	Answer	Q.No.	Answer
1	B	26	D	51	D
2	C	27	B	52	A
3	B	28	A	53	C
4	B	29	C	54	B
5	A	30	A	55	B
6	D	31	D	56	D
7	D	32	D	57	C
8	D	33	C	58	D
9	C	34	C	59	B
10	C	35	D	60	D
11	B	36	A	61	
12	B	37	B	62	
13	C	38	C	63	
14	C	39	B	64	
15	B	40	C	65	
16	A	41	A	66	
17	D	42	B	67	
18	C	43	C	68	
19	A	44	B	69	
20	B	45	A	70	
21	D	46	A		
22	C	47	B		
23	B	48	D		
24	B	49	B		
25	C	50	B		

Note/Remarks : Questions 16 to 25 carry 2 marks each

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